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6

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Grids, Gods, and Giants of the North Sea

Nancy Couling

The first major discovery of oil in Europe was made in the North Sea in December 1969 by the American company, Philipps. This historic event confirmed that the North Sea contained hydrocarbons in promising commercial quantities and placed it at the center of international interest, reconfiguring the global geography of oil. Since that discovery and reaching a peak in the 1980s, the existing landside petroleum infrastructure has been extended and diversified, creating an important offshore petroleumscape in the North Sea. While oil had previously been extracted close to shore in the Gulf of Mexico and in the shallow waters of the Persian Gulf and the Caspian Sea, the depths and wave heights of the North Sea represented new challenges. Europe was eager to reduce its dependence on oil, which was imported primarily from the Gulf.

Similar to the one on land, the offshore petroleumscape is complex and palimpsestic, with the critical difference being that it is not entangled with other fixed structures. It has established completely new sets of relations to the established petroleum nodes as well as to new geographic places on- and offshore. Offshore, the petroleumscape is made up of unprecedented, tailor-made, extended territorial frameworks—the sea needed to be prepared for such an extension of industrial activities as it had previously been a fluid space held open in the interests of trade. The establishment of the offshore petroleumscape gave companies and corporations temporary rights to inhabit sea space, install fixed structures, and carry out a new type of production at sea.

The North Sea is a particular example of this sea-based petroleumscape. Organized around these abstract regulatory frameworks, the offshore petroleumscape became a physical space constructed to high technical requirements with vast amounts of concrete and steel. Over time, and in particular at the 1980s peak, offshore fields developed into complexes with diversified uses and large rotating workforces—assuming the characteristics of artificial urban archipelagos in their own right. "Ekofisk City,"[1] on the Norwegian continental shelf, is exemplary of this urban dimension. More intangible are the cultural dimensions of the offshore petroleumscape, in particular within the Norwegian context: it is

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a mythological space, a legendary space of everyday culture, and in selected cases, a *historic artifact* which is digitally preserved.

The combination of specific state-led territorial organization, physical production of space, and everyday working life are indicators of specific processes of urbanization, first proposed by Henri Lefebvre[2] and more recently further articulated in Neil Brenner and Christian Schmid's theory of planetary urbanization.[3] The petroleum industry was largely responsible for the creation of a new offshore production space at the outset, and the resulting petroleumscape, as explored in the examples outlined in this chapter, can be understood as a powerful vehicle of the urbanization of the sea.[4] Now the most industrialized sea in the world,[5] the North Sea has produced a particular type of offshore urbanity in conjunction with the construction of its petroleumscape. The offshore petroleumscape leaves a formidable territorial legacy: it has set a precedent in transforming the North Sea into an *energy seascape*, which is being appropriated, renovated, and redirected toward renewables at the same time as processes of optimization are extracting the last hydrocarbons from existing fields and finding other substances to inject into their hollowed-out subsea spaces.

The first part of this chapter gives a historical overview of interactions that have determined and formalized spatial definitions at sea and it describes the context within which the postwar offshore petroleumscape emerged as a transnational extraction grid in the North Sea. The prolific production, longevity, and widespread sociocultural impact of North Sea oil and gas make it a valuable case study of the offshore petroleumscape discussed in the chapter's second part. Here, its physical and cultural layers are examined more closely: the Ekofisk City complex located in the middle of the North Sea, the political influence exerted in naming newly estabished geographic places offshore, and the absorption of the oil industry into specialized strands of Norwegian maritime culture. The third part considers how emerging post-oil energy strategies are perpetuating the extractivist practices and established petroleumscape of previous generations. Rather than wholesale post-oil abandonment, current developments demonstrate a range of scenarios set to maintain the unprecedented, systematic reprogramming of sea space that has taken place on the North Sea continental shelf.

Preparing the Offshore Petroleumscape of the North Sea: A Brief Historical Overview Before 1964

Seas are tangible historical spaces that have harbored and facilitated continuous exchanges. In Europe, human interaction with the sea has been accompanied by instruments of measure and control, both of which are a prerequisite to planning. Formalization of these spaces into legally bound units is a political act involving either negotiation or the execution of power. Early alliances and rivalries between tribes, political units, or confederations at sea were fluid and dynamic, similar to the situation that prevailed on land. Initially a platform for fluid material and cultural exchange between important urban centers, the sea space—such as notably the North Sea—has become a fixed production site serving—but increasingly severed from—landside hubs. The offshore petroleumscape has played a significant role in this transformation.

The North Sea is exemplary. The story of its rich history of trade and cross-cultural exchange includes the Frisians (from the seventh to the eighth centuries), followed by the Vikings (from the mid-eighth to the twelfth century), and the Hanseatic League

(from the twelfth to the fifteenth centuries). Before mobility infrastructure on land was well developed, because it was easier to travel by freshwater or saltwater routes than on land, the North Sea became the major logistical space of the region. The history of sea space was intimately tied to that of urban culture in the major cities of London, Antwerp, and Amsterdam, because it was through the North Sea that critical connections were established and maintained between centers whose wealth frequently depended more on international trade connections than on hinterlands.[6] This was particularly true for the Viking capital Hedeby and ports such as Bergen, Bruges, and Aberdeen. Likewise, people were frequently on the move around the North Sea region, profoundly influencing local languages, traditions, music, and creating a shared culture.[7]

Human interactions across the land-sea threshold result in territorial practices which shape the sea, both physically and conceptually. In northwestern Europe, the way in which we understand sea space in relation to urban space has changed dramatically since the late seventeenth and early eighteenth centuries. Traditionally, the sea provided a medium through which urban systems were loosely extended and a space within which to capture resources, demonstrate power, and carry out free trade. With the rise of the nation-state, there was less recognition of the fluid, extended forms of urbanity sustained by the sea and a process of increased appropriation and enclosure began to unfold around the emerging offshore petroleumscape.

After World War II, it was largely because of pressure from the petroleum industry that the first comprehensive legal framework for the ocean was formulated—historical legislation that opened up a vast new territory to a new type of industry for the North Sea, executed through urban devices and ultimately leading to the construction of specific new geographic places of urban dimensions. The concept of mare liberum was the doctrine of the freedom of the high seas in the general interests of humanity, defended by the Dutch jurist and philosopher Hugo Grotius in 1609 in the book of the same name.[8] This book was a response to the threat of a Portuguese monopoly on the East India trade route. Mare liberum was well suited to the ambitions of maritime trading nations, and was therefore upheld alongside the widely accepted notion of a coastal strip of territorial sea about the width of a cannon shot, which, in the early eighteenth century, was formalized by the Dutch to a width of three nautical miles.[9] Hence, while the sea was an essential space of connection and full of maritime activity, it was also conceived and maintained as a fluid space distinct from land and free from territorial domination.

The extension of sovereign exploitative rights into the sea was inextricably linked to the search for oil. The delineation of the territorial sea remained relatively unchanged until after World War II, by which time Western Europe had shifted its energy source from indigenous sources such as coal to become heavily dependent on oil, mostly imported from the Middle East.[10] Apart from initial offshore drilling in shallow waters of 3–7 m off the California coast at the end of the nineteenth century, the ocean remained a boundary for oil exploration until the 1930s.[11] By this time, onshore fields had become difficult to find around the Gulf of Mexico and large geological surveys predicted offshore finds; the refinery infrastructure was already in place along the coast due to the importance of shipping to transport oil. In 1938, the Creole field produced the first oil from "open waters" 4.5 m deep and 1.6 km into the gulf.[12] These explorations were well within the three-nautical-mile limit, but after steel became more readily available at the end of the World War II, the oil and gas industries experienced a boom and companies raced to find oil farther out in the Gulf of Mexico.

In 1945, under pressure from the petroleum industry, US President Harry Truman declared all natural resources on the continental shelf under US jurisdiction.[13] This was an unprecedented expansion of national territory into the sea and unleashed a series of similar claims from other nations. Under these circumstances, and in combination with other pressures on the world's oceans such as the threat of pollution and the need to regulate the expanding shipping trade, the UN initiated the first comprehensive legal framework for ocean space. This process began in 1949, resulting in the first UN Conference on the Law of the Sea (UNCLOS) in Geneva in 1956 and the subsequent finalization of four conventions relating to the Territorial Sea (1964), the Continental Shelf (1964), the High Seas (1962), and Fishing and Conservation of Living Resources of the High Seas (1966). The continental shelf itself was here defined according to the possibility of resource exploitation in terms of what was possible at the time:

> the term "continental shelf" is used as referring (a) to the seabed and subsoil of the submarine areas adjacent to the coast but outside the area of the territorial sea, to a depth of 200 meters or, beyond that limit, to where the depth of the superjacent waters admits of the exploitation of the natural resources of the said areas.[14]

These initial four conventions were subsequently replaced by the UNCLOS in 1982, which included a more precise definition of the extent of national offshore resource extraction within a littoral nation's Exclusive Economic Zone.[15] It is imperative to note the implicit underlying liaison between petroleum and the formalized territorialization of ocean space from the outset. UNCLOS 1982 was the first fundamental legal territorial concept to operate on an international scale. Its implementation has resulted in ongoing spatial reconfiguration of the planetary ocean and seas; according to EU directives, all coastal nations are required to have Maritime Spatial Plans for their Exclusive Economic Zones in place by March 31, 2021.[16] UNCLOS laid the foundations for the establishment of large-scale planned seascapes and the emergence of a radical new urban realm within the unfolding history of planning.[17]

Prior to the UN regulations outlined above, the existing petroleumscape had utilized the sea only as a transport surface to connect the global oil supply and delivery networks. Extraction was only taking place offshore in a tentative way in areas close to shore. However, in addition to the feedback loops, described by Carola Hein, as imperative to the ongoing reinforcement of the palimpsestic petroleumscape, this fundamentally capitalist-driven operation relies on expansion to secure the ongoing accumulation of capital. Both David Harvey[18] and Neil Brenner have discussed the de-territorializing effect of capitalist socio-spatial dynamics as, in Brenner's words, "capital's drive toward spatial expansion, temporal acceleration and relentless spatiotemporal restructuring,"[19] which is accompanied by dependence on territorially rooted, built infrastructure to achieve the same objective. I argue that the extension of the petroleumscape into the offshore exemplifies these processes. The following section explains how this expansion took place in the North Sea.

Subdivisions of the North Sea Since 1964

In 1964, several North Sea countries passed acts that effectively released the North Sea from its status as a common space and turned it into a vast, gridded site of petroleum exploration

and production which marked a watershed in Northern European urbanization processes. Firmly controlled by governments and industrialists, the implications were neither thoroughly discussed in terms of planning nor, until recently, theorized. Immediately subsequent to the establishment of the first legal regulation of the seabed, an entire sea, 600 km wide, became a territory opened up for development. Previously not considered a potential source of hydrocarbons, in the 1960s the North Sea rapidly developed into the focus of international exploration activity with competition between neighboring countries, organized around newly determined offshore borders.

Within the hitherto "undeveloped" space of the sea, the petroleumscape could freely expand without concern for, or conflict with, existing urban layers, yet it is inextricably linked to the physical networks and energy demands of landside urban agglomerations. The theory of planetary urbanization, in particular "extended urbanization," provides a useful way to think about such remote and unevenly dispersed sites that operate within a stretched, dialectical relation to urban centers.[20] Within the reciprocal urban processes of "implosion and explosion,"[21] extended urbanization refers to the far-reaching systems and mechanisms set up to support urban agglomerations. These systems selectively cross and erase historical borders between inherited categories such as the urban and the rural or land and sea, sometimes densifying into extreme and unfamiliar settlement formations charged with circulating goods and data, extracting resources, and engaging in specialized production. In contrast to the earlier fluidity of extended commercial and cultural connections across the North Sea, the strategic instruments applied in the process of extended urbanization fundamentally changed the nature of the seascape into a fixed set of Cartesian coordinates designed to produce a seascape "operationalized"[22] for the extraction and production of oil and gas.

The giant Slochteren gas field near Groningen in the Netherlands, discovered in 1959 and proving to be the second-largest natural gas field in the noncommunist world, stimulated further exploration on the continental shelf, leading to the realization that gas formations extended seawards.[23] Legislation for drilling outside of Dutch territorial waters had not yet been set in place and hindered further exploration until 1967. But in the UK, the government was keen to capitalize on international oil companies' intense interest in the North Sea and quickly prepared to begin issuing licenses. Before the UK Continental Shelf Act of April 1964 was passed and the "median line" separating UK and Norwegian waters agreed upon (May 15, 1964), the UK Ministry of Power prepared the first licensing areas by dividing the global geographical baselines of 1 degree latitude by 1 degree longitude into 30 blocks of 100 mi^2.[24] In total, the offshore area comprised 960 such blocks or 86,000 square miles. A notice inviting applications for production and exploration licenses was issued on the same day as the Act and Regulations became effective, and by September of the same year, 52 licenses covering 394 of the 960 blocks were issued to 22 applicants and a total number of 51 companies.[25]

The wholescale subdivision of the North Sea into developable blocks, comparable to greenfield development sites on land, was not questioned by the UK's Ministry of Power. Likewise, according to geographer Keith Chapman, legal questions about the ownership of the seabed were mere details for the oil industry: "The activities of the oil industry made these issues a matter of practical importance rather than philosophical debate."[26] The UK government was well aware of their advantage over other North Sea countries in pushing through rapid legislation and offering blocks for exploration. Their goal was to "incite the

maximum of activity,"[27] encouraging oil companies to initiate and maintain operations in the UK part of the North Sea.

As a device of preliminary appropriation around which hydrocarbon infrastructure is organized, the grid represents a powerful vehicle of extended urbanization. While familiarly banal, the grid belies the spatial power executed by the North Sea littoral states. With the exception of Germany, which awarded rights to a consortium for the entire area, the grid system was subsequently adopted by neighboring North Sea countries with slight variations in the interest of promoting rapid exploration (Figure 6.1).[28] Norway, for example, adopted a 500 km^2 or 200 mi^2 subdivision of the block in 12 units rather than the 30-unit UK division and released 278 blocks for licensing in the first round in 1965, including the whole

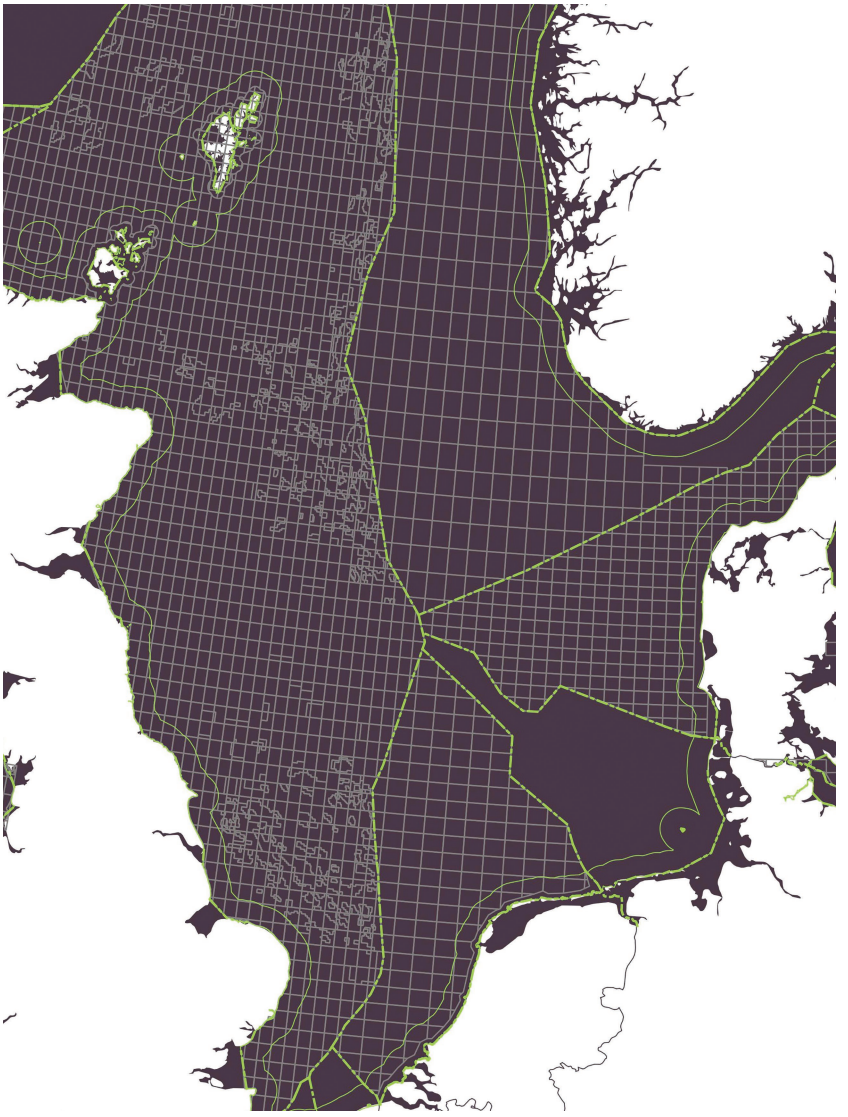

FIGURE 6.1 North Sea petroleum grid. Map by Nancy Couling.

Norwegian continental shelf south of the 62 degree parallel.[29] The vast and abstract grid was circulated as a plan only within government and petroleum industry circles. Although not visible per se, the grid established an immutable, orthogonal, and highly resilient referential layer, presupposing the possibility of seafloor development anywhere within its range, while in theory the water column still remained a dubious "commons" effectively rented out to transient oil rigs.

In the 1960s, over 200 exploratory wells were drilled in the North Sea. Gas was discovered by Conoco/National Coal Board in the UK sector at the Viking field in 1965 and the Hewitt (Arpett Group) and Leman Bank fields (Shell/Esso) in 1966, the latter proving to be the world's sixth-largest offshore gas field, and it transformed the British gas supply industry.[30] The abstract grid was therefore activated into a series of nodes of intense technological and human activity as floating or jack-up drilling rigs were relocated and accommodation platforms were installed, while workers circulated by helicopter and service vessels delivered supplies and equipment. As gas fields came online, a system of delivery pipelines and receiving terminals at the coast was also required. At this time, North Sea waters presented the most demanding offshore environment, surpassing previous technical limits of depth and wave height. Previously, depths of over 400 feet (ca. 122 m) had been considered "deep." In the central North Sea, "one of the world's roughest bodies of water,"[31] depths were up to 500 feet (152 m) and waves reached heights of 75–100 feet (22–30 m).[32] Construction systems inherited from more benign seas such as the Persian Gulf had to be adapted to these new conditions. In 1968, the Cod gas field was discovered in the Norwegian sector, followed by the 1969 discovery of Ekofisk, the first major commercially viable oil field in the North Sea. Ekofisk was a giant find and due to the density and complexity of its offshore infrastructure, its early discovery, and subsequent longevity, it irrevocably transformed the North Sea into a dedicated petroleumscape and made Norway a society based on oil.

Physical and Cultural Dimensions of the Offshore Petroleumscape: The Case of Ekofisk

Offshore sites such as Ekofisk represent a new type of "place" in the history of Northern European urbanization. These large, complex structures were sites of intensive work relations, material transformations, and international nodes of cultural and technical exchange. They also outlived their productive stages to mature into places of historical significance. Ekofisk City not only demonstrates the physical extent of the offshore petroleumscape, but also is an example of extended urbanization at sea. Offshore, the petroleumscape acquired the additional social dimensions of living and recreational facilities, producing an everyday culture of the sort identified by Hein as still lacking in existing debates of the petroleumscape.[33] Restricted socially, spatially, and temporally, Ekofisk City was a specific type of urban format that emerged offshore. With two generations of an offshore workforce having been employed there for much of their working lives, it has become a lasting cultural artifact.

The Ekofisk complex had the densest concentration of offshore installations and flow lines in the whole North Sea. Located at the southernmost extremes of the Norwegian continental shelf, with water depths of 70–75 m,[34] the area developed in stages. It comprises the four fields—Ekofisk, Eldfisk, Embla, and Tor—and six further fields (including Cod) that have ceased production, with a total of thirty-two platforms (Figure 6.2). The "center" of Ekofisk was a series of eight platforms and two flare stacks connected by pedestrian

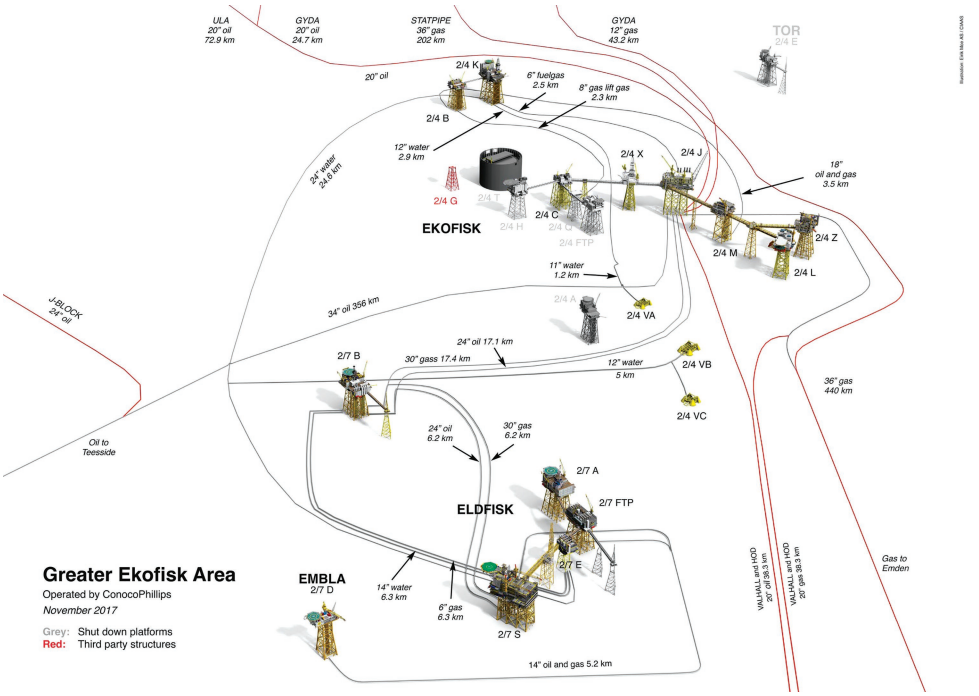

FIGURE 6.2 The Greater Ekofisk Area. *Source*: ConocoPhilipps.

bridges.[35] Ekofisk occupies a central place in Norwegian history, not only because it was the first producing field on the Norwegian continental shelf, but it also presented multiple technical challenges and ultimately established new Norwegian competence in the oil industry. It has been hailed as "a pioneering effort that ushered Norway into the oil age."[36]

Between 1974 and 2004, Ekofisk brought Norway US$190 billion from oil and gas sales, equivalent to 20 percent of Norway's total production during this period.[37] Members of more than fifty different professions worked on the Ekofisk complex, with between 7,000 and 8,000 employees there during the construction phase of 1972, making up a population four times larger than most Norwegian coastal towns.[38] Ekofisk represents a shift in construction, economics, and national policy that transformed Norwegian society.

At Ekofisk City—the name partly reflecting its complexity and partly the shift from temporary installations to more permanent facilities and structures—new fields and discoveries continued to be linked into the complex—it was never clear during the first phase of development how large this city would grow.[39] The Ekofisk site generated continuous and intense circulations of "rig tours,"[40] supply vessels, rigs being hired out for limited contracts and transported to new sites around the North Sea and beyond, and of the flow of oil itself. Parallel to this continuous movement, Ekofisk also received units characterized by new dimensions of limited permanence: between 1972 and 1974, facilities enabling the production of oil around the clock were installed, dedicated accommodation platforms connected with bridges were fixed to the seafloor, and a concrete storage tank was set in place. The concrete foundations for the connecting bridges used a system never before tested offshore. The concrete storage tank—a "cube with dimensions of a standard city block"[41]—had an external

FIGURE 6.3 Ekofisk storage tank. *Source*: Norwegian Petroleum Museum.

diameter of 140 m and a height of 106 m, weighed 215,000 tons, and was capable of storing one million barrels of oil. The transport of this tank out to the field was a historic event, as reported by the Stavanger newspaper: "The monument to a new technological era is today journeying through our district"[42] (Figure 6.3).

At the peak period, in 1981, all platforms were functioning. By 1998, several of the platforms had already shut down production and the question arose as to how the historic nature of the ensemble could be acknowledged as a type of museum to Norway's early oil age. The Ministry of Petroleum and Energy declared it necessary to "ensure that important and historical structures were preserved and made accessible for future generations,"[43] and in accordance with the Cultural Heritage Act, the structures were awarded the status of Industrial Cultural Heritage—"some of the largest and most complex cultural monuments of our time."[44] A process of preservation and documentation was initiated for the first period from 1962 to 1998, with a particular focus on documentation for parts too large to preserve and for less tangible, sociocultural aspects of the offshore working life.

More subtle cultural dimensions of the offshore petroleumscape can be seen in Norwegian practices of naming oil and gas fields. Politicians aimed to link the industrialized sea to Norwegian heritage, in particular to Norse gods, thereby obscuring the processes of modernization and actively promoting oil and gas as part of the national cultural imagination.

In the development of the Norwegian petroleum grid described above, awarded production licenses were named numerically, corresponding to the abstraction of the grid and its unknown potential. Philipps was awarded three licenses, with license 018 covering blocks 1/5, 2/4 (Ekofisk field), 2/7, and 7/11. At the discovery and release of oil or gas from an anonymous block, a new and significant geographic place is established. Ekofisk is an elaborate assemblage of extraction and production infrastructure erected above the choppy

surface of the North Sea, beyond the safety margin of the "one-hundred-year wave" (the estimated maximum North Sea wave height that determined the platform level was set at 78 feet/23.77 m at Ekofisk in 1971). But it is more fundamentally an ancient reservoir of hydrocarbons dating from the Paleocene, comprising an oil column of over 300 m in height located at depths between 2,900 and 3,250 below the seafloor—depths which dwarf the spindly twentieth- and twenty-first-century structures perched above the seafloor and piercing its interior. This reservoir is part of the geological system also named after Ekofisk—the Mandal-Ekofisk petroleum system of sedimentary rocks called a pod of active source rock, which encompasses a vast area of around 90 × 280 km below the central North Sea. The Ekofisk reservoir itself is one of many within this formation, its outline measuring around 9 × 12 km. Through technological infrastructure, sites such as Ekofisk connect almost inconceivable scales of time and space, which through production processes have been transformed into nearly equally inconceivable scales of wealth and power.

The naming of the Ekofisk field was random, but vaguely referred to an imaginary North Sea fish:

> Phillips had used letters to identify the various exploration areas on the Norwegian Shelf… It started with A-blocks, B-blocks, etc. The idea was to call the fields by the names of types of fish… in exploration area «C», it was easy to find the name of a fish to correspond—Cod. But what fish had a name that began with E? Eel had already been used on a structure on block 2/7. Earl Walters at Phillips' London office suggested Ekofisk, and no one objected. So Ekofisk it was—even though it should have been spelled Ekkofisk in Norwegian, or Echofish in English.[45]

Subsequent naming exercises on the Norwegian continental shelf were carried out more deliberately as the national oil industry progressed and after both Statoil and the Norwegian Petroleum Directorate were established in 1972–1973. The Ministry of Petroleum and Energy established rules regarding the naming of fields on the Norwegian continental shelf: oil companies could suggest names, which must then be approved by the Norwegian Petroleum Directorate, based on a preestablished list of approved names. According to Norwegian language specialist Botolv Helleland, oil field names fell into five categories: fish and seabirds, mythology, sagas, fairytales, and miscellaneous, with mythological names making up about 45 percent of the total.[46] Philipps named their second field Edda in 1972—a name originating from a group of poems on Norse mythology. The chief god in Norse mythology, Odin, his wife Frigg, his sons Tor, Vale, Balder, and Brage, his brother Vilje, and his spear Gungne all lent their names to Norwegian oil fields.

The Ministry of Petroleum and Energy clearly intended to link the oil fields to symbolic figures and to Norway's cultural history:

> Names are important symbols. This is also the case for petroleum deposits. The names of many fields in Norway are taken from Norse mythology, with strong roots and steeped in national tradition. This is a tradition that should be continued.[47]

Helleland argues that the mythological names reflect the pioneering spirit and sense of adventure that predominated in the initial age of Norwegian oil.[48] While many international companies also operate on the Norwegian continental shelf, national control

executed by the Norwegian Petroleum Directorate and the dominance of Statoil resulted in a nationalistic, colonial approach to the naming of fields in 1972–2010, marking Norwegian space at sea and contributing to the forging of oil identities indirectly related to heroic Norse figures.

By 2010, the ministry also stated that the repertoire for these types of names had already been largely exhausted during the first phases of oil production on the Norwegian continental shelf and that names for the new era should reflect the oil industry's importance, "to ensure that they fit into a national context and history."[49] The Norse goddess Frigg presides over the exemplary Norwegian gas field that crosses the international border into UK waters. Both marking the maximum geographical limits to extraction potential on the Norwegian continental shelf and breaking new ground in international law through joint international exploitation, Frigg is an unmistakable nationalist symbol and physical border post in an artificially constructed, mythological sea of oil (Figure 6.4).

FIGURE 6.4 Plaque to the goddess Frigg. *Source*: Nancy Couling.

Through these practices, the construction of the offshore petroleumscape is both linked to something distant and surreal and to heroic acts of mythological proportions which reinforce a sense of national pride and identity. Such narratives correspond closely to the "petroleum imaginaries": as Hein observes, film and literature have "celebrated oil as a heroic partner in creating contemporary society and our identity."[50] Rather than the dissonant reality of concrete and steel installations occupying the sea, the modern industrial narrative is disguised in powerful premodern and superhuman imagery.

The Norwegian petroleumscape did not expand incrementally into the offshore realm; rather, it emerged directly at sea. Due to the location of formations, there was no established landside petroleum extraction industry as there was around the Gulf of Mexico. Norway was already an established maritime nation and it was through expertise in seafaring, maritime trade, and shipbuilding that the Norwegian industries initially adapted to oil.[51] As these traditions were steered into the oil industry, the petroleumscape became synonymous with a new maritime identity of oil. In addition to the official naming practices linked to Norse mythology, workers recruited from traditional maritime industries created an additional stream of Norwegian maritime culture for the offshore petroleumscape.

Fishing had previously provided Norway's primary export earnings. In comparison to long fishing tours of up to seven weeks, followed by one week off, working on a rig at the currently established Norwegian norm of two weeks on and four weeks off is considered an acceptable rhythm. Offshore workers talk about the ways in which maritime culture has been diverted into oil; most coastal Norwegians love the sea, and despite the tough working conditions offshore, workers have a keen sense of adventure and wanted to experience this new challenge.[52] An electrician who worked for thirty-five years at Ekofisk described how regular office work did not suit him and how the large numbers of ex-seamen familiar with maritime life knew how to create a good working atmosphere offshore. Strong bonds were formed with workmates.[53]

Oil was an industry of which the ex-seamen had no previous knowledge, but the oil industry did offer opportunities to apply existing expertise to new endeavors. Along with shipbuilding, Norwegians were also experienced in hydropower, and as the construction challenges in the North Sea emerged in full, it was the technology of concrete construction that Norway adapted and promoted for the offshore context. Concrete Deepwater Structures (Condeep) produced fourteen gravity base structures (GBS) in the North Sea from 1975 to 1995. The last and tallest of the Condeep structures built for the Troll field, located in 300-m-deep waters, was 360 m high, contained 245,000 m^3 of concrete, and 100,000 tons of reinforcing steel. At the time (1995), it was considered the tallest structure ever moved by humans.[54]

In order to acknowledge the human ingredient among the giant offshore machines and the individual contributions to the oil industry, documentation projects, including oral histories, have been carried out in connection with the Norwegian Industrial Heritage project and the British Library and Aberdeen University's "Lives in the Oil Industry" project.[55] Offshore oil quickly established itself and became a newly established "maritime" way of life around the North Sea.

The Post-Oil Petroleumscape

After the 2002 merger of Conoco and Phillips, the company announced the Ekofisk Area Growth project to improve oil and gas recovery at Ekofisk. In 2011, the government approved

the development of two additional fields in the region, Ekofisk South and Eldfisk II, hence Ekofisk is expected to continue producing until 2050. The Norwegian petroleumscape is far from retired; in fact, the Ministry of Petroleum and Energy cite their current objectives and challenges as including "improved recovery from fields, development of discoveries and proving undiscovered resources."[56] In the example of Ekofisk, improved knowledge and technology means that the original expected recovery rate of 17 percent has now been improved to around 50 percent.[57] The official Norwegian petroleum strategy is justified by the overriding societal benefits gained through the industry, which has developed into what I would call an overwhelming *ecology of oil* penetrating all levels of Norwegian society. Comparable to a complex system of interdependent parts, like an ecosystem, the logic of oil permeates multiple spatial, organizational, and conceptual levels. This corresponds closely to the concept of feedback loops to maintain dependence characteristic of the "palimpsestic global petroleumscape."[58] In the words of the ministry, "Since the 1970s, the substantial revenues from the activity have helped build the Norwegian welfare society.... The petroleum resources should also contribute to improving the quality of life in Norway in the years to come."[59]

This line of argument has been sharply criticized by Latin American environmentalist Eduardo Gudynas in his discussions of neo-extractivism, where the state has become more involved in resource extraction and invests in social programs to "generate legitimacy" and to pacify local demands, such as those regarding environmental hazards.[60] Norwegians have been largely convinced that their Government Pension Fund is a wise and exemplary investment. In terms of the inherent meaning of sustainability, it is ironic that securing monetary resources for future Norwegian generations has been based on the exploitation of nonrenewable resources. With the current state of global carbon dioxide emissions failing to reach agreed objectives, vast investments will urgently be required in order to repair the global damage caused by petroleum.

Although Norway has not yet turned away from petroleum, there have been moves to prepare for a post-oil future. The offshore terrain established by North Sea petroleum provides the legislative framework, some of the technical expertise, and an established infrastructure for the energyscape of renewables at sea. Wind has emerged as a second-generation energy source in the North Sea and the wind industry is retrofitting the offshore petroleumscape as the oil industry begins the process of decommissioning. Germany and Denmark, both nations with a tradition of innovation in onshore wind energy but without significant offshore hydrocarbons, have been the European pioneers in offshore wind. Legislation moved forward particularly swiftly in Germany, the first European country to establish a Spatial Plan for its Exclusive Economic Zones in the North and Baltic Seas in 2009.[61] The North Sea plan laid out vast priority areas for offshore wind energy development, seen by the German government as an answer to its ambitions regarding the transition from coal and nuclear power to renewables.

The European Environmental Agency has identified the North Sea as an important European location for offshore wind, due to good wind speeds in combination with shallow water (<50 m) and its close proximity to the heavy energy consumers of highly industrialized northern Europe.[62] Offshore sites are released by the state for development, and therefore both land-based issues of ownership and potential NIMBY, an acronym for the phrase "not in my backyard," disputes are avoided. Since the installation of the first offshore wind turbine in 1991 with a height of 52.5 m and a capacity of 0.45 MW, turbine sizes have increased exponentially, exploiting the advantages of the industrial scale offered by the

offshore environment. GE Renewable Energy is currently releasing a 12 MW turbine: the Haliade X-12 stands 260 m high (only 60 m less than the Eiffel Tower) and has a rotor diameter of 220 m. Turbines of these dimensions require large downwind spacings; therefore the occupied surface is expanded accordingly to include unprecedented areas of delineated offshore space.

Petroleum ushered in urbanizing instruments which were applied to the North Sea, first producing a gridded territory of resource extraction and then an industrial site of energy production. The establishment of this offshore site has been instrumental in the conception and execution of offshore wind, preparing the way for its development. In their discussion of planetary urbanization, urban theorist Neil Brenner and colleague Nikos Katsikis refer to such previously "natural" areas that have been transformed into instrumentalized production sites across the globe as "operational landscapes."[63] Resonating with this definition, the North Sea has become an operational seascape, which once established becomes a semi-permanent feature. At the termination of a typical twenty-five-year operating license, offshore wind parks are "repowered" with the latest generation of turbines, but due to the difference in scale which determines the foundation layout, existing foundations cannot be used and the site undergoes another round of "creative destruction."[64] Just as the petroleumscape is continuously extending and rebuilding itself, so must offshore wind adapt to technological improvements. Offshore, this means that it is not human habitats that will be displaced, but marine habitats, recently reestablished after the first round of construction, and the marine life they support.

Offshore wind and oil have become close neighbors in the North Sea as all littoral nations expand seawards with renewable energy production. This is not all they have in common; as part of the strategies to "optimize" remaining assets, wind and gas companies discuss possibilities of delivering "clean," cheap energy to unmanned gas rigs to power their production, in particular in the southern part of the North Sea.[65] Further potential synergies exist in the area of logistics—supply, crew, and safety vessels could be shared. The current 1,000 offshore turbines in the North Sea each weigh around 1,000 tons—equivalent to an unmanned oil or gas installation, therefore foundation systems are comparable and certain technological solutions can be exchanged.

In the German North Sea, the manpower required to maintain wind farms has been grossly underestimated. Consequently, accommodation options must be considered and the wind park Dan Tysk (Vattenfall) has constructed a stand-alone fifty-berth accommodation platform 90 km from shore. As the oil industry moves increasingly toward automated operations at the remaining stations, the wind industry is physically expanding offshore, requiring more diversified functions such as convertor platforms, small power stations, and more permanent accommodation.

Companies previously uniquely associated with oil are now moving into wind energy, demonstrating the direct link between the offshore petroleumscape and its successors. In May 2018, Statoil announced it was changing its name to Equinor. Pursuing similar development strategies as many oil companies and state institutions, Statoil has long been expanding into renewables, and recently it boasted the completion of Hywind, the world's first floating wind park off the coast of Scotland. Equinor has secured consent for developing the Creyke Beck B wind park at the Dogger Bank. They claim it is the largest zone available for wind development in UK waters and will accommodate 200 turbines in water depths of 20–33 m. Currently the world's largest offshore wind park is the Walney Extension in the

Irish Sea, with 87 turbines, a total capacity of 659 MW, and covering an area of 145 km^2.[66] The refashioned Equinor presents itself as a socially responsible company moving toward gas, solar, and wind energy, but says less about the opening up of new oil and gas extraction sites in the delicate Barents Sea, one of Europe's last intact marine ecosystems.[67]

The North Sea petroleumscape is proving to be a valuable asset for future energy scenarios. Depleted reservoirs are being used as the sites for carbon capture and storage. For example, the Utsira formation receives carbon dioxide produced by the processing of gas and condensate at the Sleipner platform, operated by Equinor.[68] In the Netherlands, studies are being carried out on the feasibility of converting electricity from renewable sources into hydrogen. Storage of renewable energy is a problem, therefore its transformation into hydrogen enables renewable energy to be more readily stored as well as to be directly used for mobility, transport, and further industrial applications. The existing petroleumscape provides useful spatial resources; possible storage sites include depleted gas deposits on the mainland and the continental shelf as well as large areas containing tanks comparable in size to existing facilities for the storage of oil and other petroleum products at ports such as Rotterdam.[69] Technology enables the physical extremities of the petroleumscape, drilled to depths reaching 3,000 m below the seabed, to be recycled for either the excess "products" of a petroleum-dependent society or for the as-yet uncertain flows of alternative forms of energy.

Conclusion

The North Sea petroleumscape is a sprawling and unfamiliar agglomeration of grids, gods, and giant machines, which challenges our inherited understandings of geographic place. The resulting combination of contradictory elements is characteristic of extended urbanization processes and, in the North Sea, petroleum was a major force in the initial unleashing of these processes. Governments borrowed the classic urban ordering device of the grid to organize petroleum licensing areas, hence essential referential coordinates were established for potential new geographies of oil. These references then developed into clusters of platforms and complexes such as Ekofisk City, which became international centers of work, recreation, and the production of wealth, around which uninterrupted global activity has revolved. While physically remote, dispersed, specialized, and constrained, these sites accommodate critical activities which serve urban centers around the North Sea and beyond.

In the Norwegian North Sea, new offshore places were linked to mythology and Norse culture through strategic naming practices and have since become established virtual places in the national landscape of industrial cultural monuments. The petroleumscape is hence a cultural artifact, entrenched in concepts of national identity. Two generations of workers have constructed and populated it and they are now partly dismantling it; however, its efficiency continues to be optimized by technology and remotely controlled subsea templates represent the state of the art. The petroleumscape was responsible for launching a radical, unprecedented transformation of the North Sea space, and once installed, current developments illustrate its immutability. Together, governments and multinational corporations are retrofitting and reusing it for hydrogen and carbon dioxide storage. The logic of oil continues to permeate strategic narratives of offshore renewables and to perpetuate the vast and complex network of spaces and channels it has carved out of the North Sea.

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